Exploring Task Performance and User's Preference of Mid-air Hand Interaction in a 3D Docking Task Experiment

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ABSTRACT

While the technology for input (Leap Motion, Kinect, etc.) as well as output (VR headsets, large projection walls, etc.) is market ready, only few solutions for natural interaction with such devices exist. With regard to natural 3D interaction, the human hand seems to be the ideal tool for direct manipulation [3]. But, 3D interaction require more complex interaction techniques, which consequently cause higher levels of user instrumentation [1] and workload, such as physical demand or frustration. Here, a VR approach might be beneficial to the user's preference.

Lubos et al. [2] investigated mid-air 3D selection in VR and showed that users performed better when the are in a comfortable pose. In this poster we propose an approach for mid-air hand interaction with 3D content in a furniture arrangement scenario. We evaluate our technique in a 3D docking task on a large projected display versus wearing a VR headset. Our experimental results show that the translation and rotation precision benefits from the usage of a projection wall, whereas the participants preferred the HMD with regard to user experience and task workload.

KEYWORDS

Virtual Reality, Projection, Mid-air Interaction, Docking Task.

1 EXPERIMENTAL SETUP

In this work, we explore a mid-air gestural interface using commodity 3D hardware (Kinect vs. Leap) in a furniture arrangement application and compared two display conditions. The display conditions represent two potential setups that were chosen based on discussions with experts from a furniture store brand. In the first setup, the user perceives the virtual environment wearing a HMD. The second setup relies on a large projection screen and is tailored to physical furniture stores, which do not necessarily want or might not be capable to use VR yet. In both setups, the users interact with the system by hand and body gestures to manipulate objects in the scene, as well as the camera, resulting in interaction in 10 degrees of freedom (DOF).

SUI '17, October 16–17, 2017, Brighton, United Kingdom

ACM ISBN 978-1-4503-5486-8/17/10…$15.00
https://doi.org/10.1145/3131277.3134356

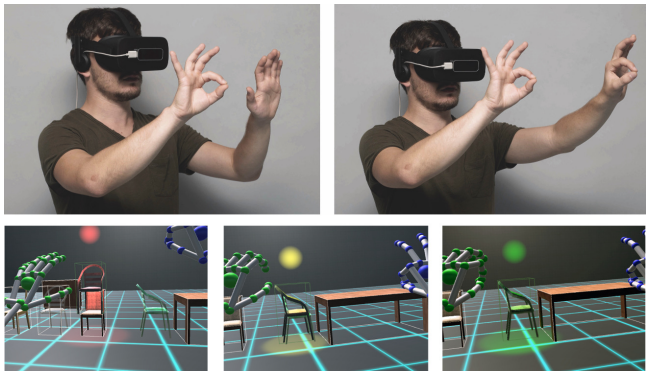

Figure 1: Bi-manual mid-air interaction in Virtual Reality.

2 EVALUATION

In an experimental study, 12 participants (2 female, age = 25.8 ± 8.6) performed a docking task, where they had to rearrange multiple 3D furniture objects. While the results showed that projection outperformed HMD with respect to speed ($29.8s \pm 11.6$), position precision ($97.8\% \pm 0.8$), and rotation precision ($99.2\% \pm 0.3$). The HMD was subjectively preferred by the participants concerning task workload (52.0 ± 22.6), and user experience (1.8 ± 0.5). Moreover, besides the user experience Questionnaire (UEQ) and the NASA task load index (NASA-TLX), the participants were asked to fill out the motion sickness assessment questionnaire (MSAQ), which delivered very good scores in average ($M = 0.1, SD = 0.1$).

3 CONCLUSION

The results gave insights into how commodity devices can be used in 3D interactive planning environments for customized furniture. While the experimental results showed that task performance (speed and precision) was higher in the projection condition, the HMD was preferred (user experience and workload) by the users in the 3D docking task.

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